[Fig. 5B] Fig. 5B is a longitudinal sectional view showing the tip portion of the fuel injection valve according to the fourth embodiment of the invention.

[Fig. 6A] Fig. 6A is a front view showing a tip portion of the fuel injection valve according to a fifth embodiment of the invention.

[Fig. 6B] Fig. 6B is a longitudinal sectional view showing the tip portion of the fuel injection valve according to the fifth embodiment of the invention.

[Fig. 7A] Fig. 7A is a front view showing a tip portion of the fuel injection valve according to a sixth embodiment of the invention.

[Fig. 7B] Fig. 7B is a longitudinal sectional view showing the tip portion of the fuel injection valve according to the sixth embodiment of the invention.

[Fig. 8A] Fig. 8A is a front view showing a tip portion of the fuel injection valve according to a seventh embodiment of the invention.

[Fig. 8B] Fig. 8B is a longitudinal sectional view showing the tip portion of the fuel injection valve according to the seventh embodiment of the invention.

[Fig. 9A] Fig. 9A is a front view showing a tip portion of the fuel injection valve according to a eighth embodiment of the invention.

[Fig. 9B] Fig. 9B is a longitudinal sectional view showing the tip portion of the fuel injection valve according to the eighth embodiment of the invention.

[Fig. 10A] Fig. 10A is a front view showing a tip portion of a conventional fuel injection valve.

[Fig. 10B] Fig. 10B is a longitudinal sectional view showing the tip portion of the conventional fuel injection valve.

[Fig. 11A] Fig. 11A is a front view showing a tip portion of a second conventional fuel injection valve.

[Fig. 11B] Fig. 11B is a longitudinal sectional view showing the tip portion of the second conventional fuel injection valve.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following description and the accompanying drawings, the invention will be described in more detail in terms of preferred embodiments.

[A first embodiment]

Fig. 1 is a schematic longitudinal sectional view showing a direct injection type gasoline engine to which a fuel injection valve 2 according to a first embodiment of the invention is mounted. An intake port 10 and an exhaust port 12 are connected to a combustion chamber 8 formed inside a cylinder block 4 and a cylinder head 6 as shown by dashed lines. Two intake ports 10 and two exhaust ports 12 are provided for each cylinder, and each of the intake ports 10 and the exhaust ports 12 is opened and closed by an intake valve 14 and an exhaust valve 16, respectively.

The fuel injection valve 2 is mounted in a mounting hole 17 formed in the cylinder head 6 at a location between the two intake ports 10. A tip portion 2a of the fuel injection valve 2 is exposed to an interior of the combustion chamber 8. According to this arrangement, the fuel injection valve 2 is mounted such that it can directly inject fuel into the combustion chamber 8. In the fuel injection valve 2, a nozzle hole is formed in a tip portion 3a so that an atomized mist of fuel of a relatively thin sector shape is injected. A cavity 20 is formed in a top face 18a of a piston 18. In stratified charge combustion, fuel is injected from the fuel injection valve 2 into this cavity 20 in a latter half of a compression stroke as shown by the chain line in the figure. The fuel then advances by making use of penetration force thereof along a bottom wall 20a and a side wall 20b of the cavity 20. As the fuel advances, it absorbs heat and gradually vaporizes, and is eventually deflected by the side wall 20b of the cavity 20 towards a direction of an ignition plug 22 installed on a

side of the cylinder head 6. A combustible fuel-air mixture having a good ignition performance is thereby formed around the ignition plug 22 at an ignition timing of stratified charge combustion, thus stratified combustion is enabled.

Figs. 2A and 2B show a structure of the tip portion 2a of the fuel injection valve 2. Fig. 2A is a front view and Fig. 2B is a longitudinal sectional view. A cap 24 is fitted into an outer periphery of the nozzle body 3. Though not shown, a base portion side of the cap 24 is mounted onto a main body side of the fuel injection valve 2. This causes the cap 24 to secure the nozzle body 3 on the main body side of the fuel injection valve 3.

The entire tip portion 3a of the nozzle body 3 exposed to the interior of the combustion chamber 8 protrudes in a conical shape directly from an outer peripheral surface 3b of the nozzle body. A foremost portion 3c of the nozzle body tip portion 3a is formed into a spherical shape. The spherical foremost portion 3c and a conical peripheral portion 3d are connected without forming a recessed portion (153e, 203d) described in the conventional examples (Figs. 10 and 11).

A nozzle hole 26 is formed in the foremost portion 3c of the nozzle body 3 at angles with respect to an axial direction of the fuel injection valve 2 to ensure that fuel is injected in a required angle. The nozzle hole 26 is connected to a fuel supply passage 30 via a cavity 28 formed inside the nozzle body 3, through which fuel under high pressure is supplied. A needle 32 disposed inside the nozzle body 3 is driven by an electromagnetic drive mechanism inside the fuel injection valve 2 and opens and closes the fuel injection valve 2, with a periphery of the cavity 28 functioning as the seat portion thereof.